
Results of Actel RTAX-2000S Evaluation Test

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Background

- JAXA has several plans to use Actel RTAX-2000S, which builds a large number of gates.
- Since the device has never been sufficiently evaluated for space applications.
- In 2005, we made a comprehensive antifuse evaluation of A54SX-S and RTSX-SU, devices of earlier generations and found some failure acceleration factor(voltage).

Testing

- Parts type: RTAX2000S-1CQ352E
- Test Samples: 3 pcs * 2 designs = 6 pcs
 - Lot: The same lot of the flight devices
- Measurements:
 - Functional test
 - DC test
 - Delay and Delta delay
 - Fmax
- Designs: Two similar designs of the Flight Model
 - Target: Two designs from two JAXA projects

■ Programming and Screening

- Programming: Ver. 4.64 (for Windows)
- Electrical parameter test:
 - Group A subgroup 1,7,9 and Functional Test
- Burn-in test:
 - 125 °C 240 hours
 - Supply Voltage: $V_{CCA} = 1.6V$, $V_{CCI} = 3.5 \pm 0.2V$
- Final electrical parameter test (25 °C)
 - Group A subgroup 1,7,9 and Functional Test
 - Delta Delay
- Final electrical parameter test (maximum and minimum operating temperatures)
 - Group A subgroup 2,3,8,10,11

Results : Programming and Screening

Design	A	B
Visual inspection	3/3	3/3
Programming	3/3	3/3
Interim (pre burn-in) electrical parameters test	3/3	3/3
Burn-in test	3/3	3/3
Final electrical parameter test(25C)	3/3	3/3
Delta	3/3	3/3
Final electrical parameter test (Maximum and minimum operating temperature)	3/3	3/3

Pass/Test units

- Neither DC parameters nor AC parameters fluctuated in the electrical parameter tests. The both parameters were all within the speculation.
- Fmax fluctuation was 0.2MHz (t=0.31ns), which is not supposed to cause problems.

High Temperature Operating Life test (HTOL)

Test Condition

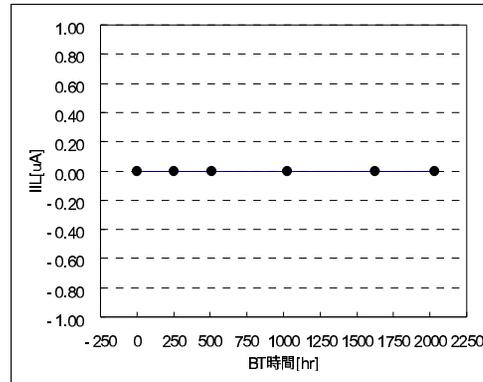
- Temperature: 125 °C
- Duration: 2000 hours
- Supply Voltage: $V_{CCA} = 1.6 \pm 0.1V$, $V_{CCI} = 3.5 \pm 0.2V$
- Operating Frequency: 0.25MHz

Electrical Parameter Tests

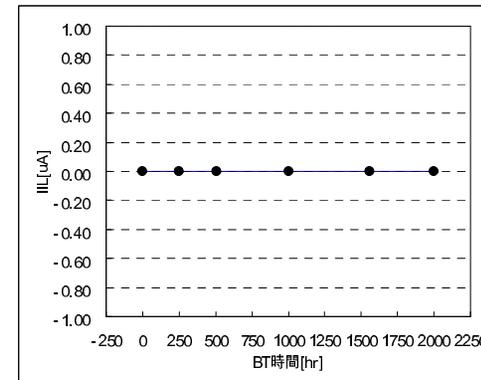
- Electrical parameter measurement
- Delta
- Measure period: 0H,240H,500H,1000H,1500H,2000H

Results : HTOL (1/3)

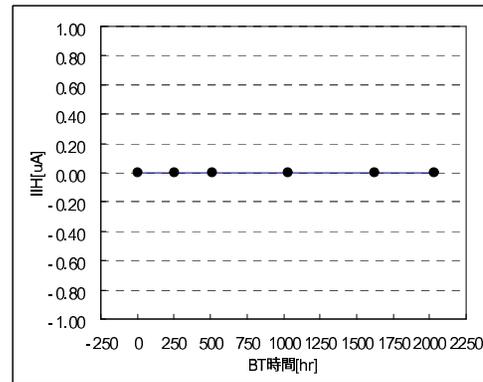
■ $I_{IL}@3.6V$



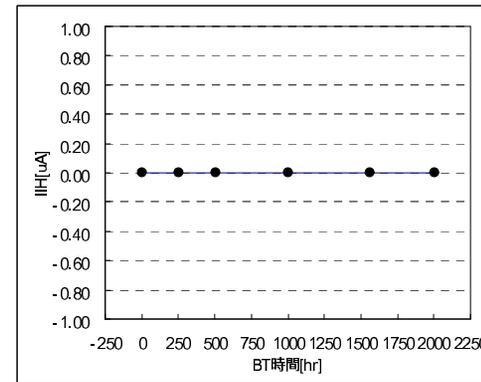
Delta limit: 0.3 μA



■ $I_{IH}@3.6V$



Delta limit: 0.3 μA



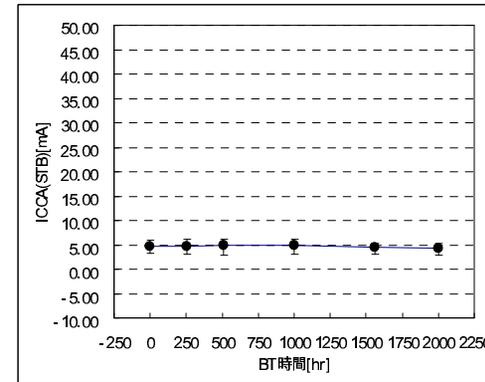
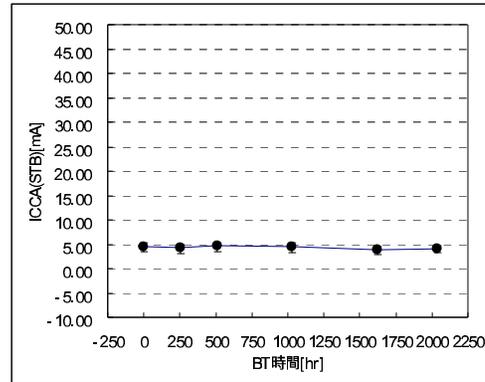
A

B

Results : HTOL (2/3)

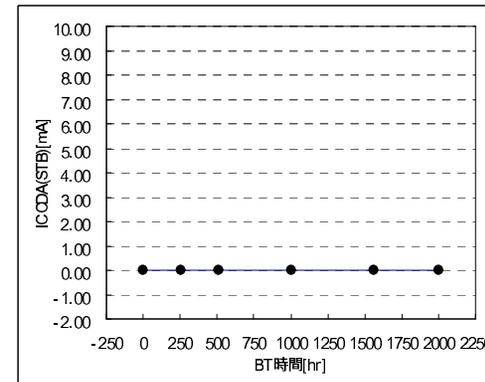
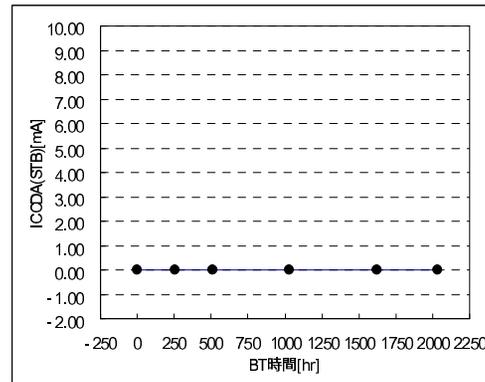
■ $I_{CCA}@1.575V$

Delta limit: 10mA



■ $I_{CCDA}@3.6V$

Delta limit: 1mA

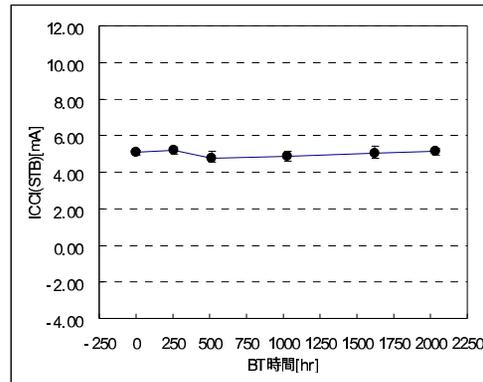


A

B

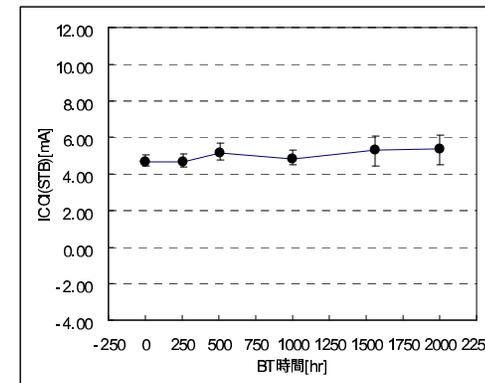
Results : HTOL (3/3)

■ $I_{CC1}@3.6V$
2.5mA



A

Delta limit:

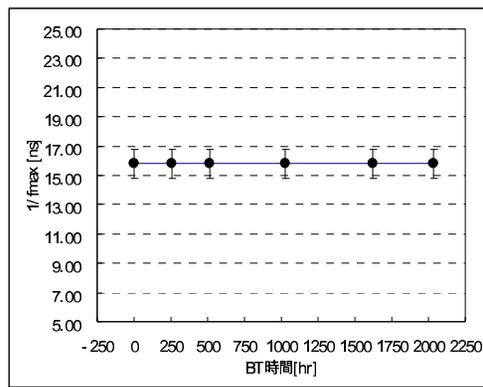


B

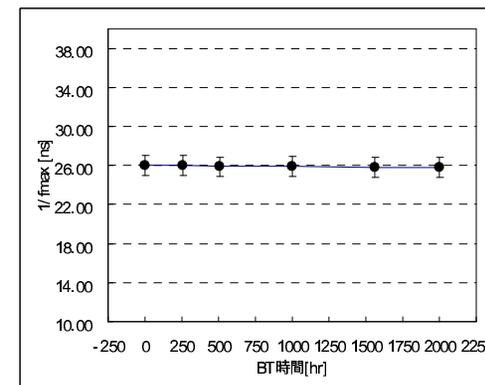
- For the both designs, measured DC parameters met the spec with an ample margin. The parameters did not fluctuate, remaining in the spec.
- AC parameters were also within the spec with an ample margin. The delta delays were from -0.4 to 0.2ns, while the delta delay spec is 10ns.

Results : Fmax

1/Fmax@3.6V



A



B

- Fmax fluctuation was 0.32MHz ($t=0.2\text{ns}$), which is not supposed to cause problems.

Summary

- After programming and screening test samples, we made a HTOL test.
- The test showed no failures in terms of DC, AC, functional test, delta delay and Fmax.
- This result suggests that the probability of malfunction will be very low, as far as we use devices of the same lot as ones used in this evaluation.
- We have established an evaluation methodology. We have already constructed DUT boards, BIBs, and so on. Now we are ready to evaluate and use the device.
- Since each FPGA application demands each level of quality and acceptable cost, we would like to upgrade our evaluation methodology so as to meet each project requirement in a cost-efficient manner.